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ABSTRACT

Computer managed instruction should be able to meet student needs immediately, remove clerical work from teachers' tasks, process information at student-pace demand, and fit the prescribed curriculum. To create such an integrated program of compatible instruction, curriculum, and information system, a Madison, Wisconsin, Public Schools Title III project has concentrated on developing management structures in curriculum, instructional sequence, space allocation, task allocation, material acquisition, materials distribution, and information structure. The overlapping of these areas creates, within the constraints of time, money, and space, the ability to individualize student learning. Each of the seven areas is explained and material from a user's manual is included. (Author/DW)

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AN INTERACTIVE MANAGEMENT INFORMATION SYSTEM FOR THE SUPPORT OF INDIVIDUALIZED INSTRUCTION: A LESSON ON HOW TO MANAGE COMPUTER MANAGED INSTRUCTION

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The process involved in trying to implement a CMI approach to individualization using an interactive information system in a elementary school has led me to regard all of the electronic magic which initially drew me to the project as the truly trivial side of the question. The most difficult task is the creation of appropriate systems of equal sophistication on the curricular/ instructional side of the problem. For C.M.I. to be accepted as the method for implementation of individualization in elementary school settings one must create a situation in which the teacher perceives that the system's sole purpose and function is to immediately meet the students unique needs upon demand. It must completely remove the clerical burden of record keeping without imposing upon teachers arbitrary and unwanted decisions or information. The system must process student information at a rate equal to the speed at which students come to decision points in the instructional process so that no student waits for information. The software package must fit the curriculum which is the driving force behind all design considerations. Lastly it must appear to increase student achievement and acceptance of the curriculum without increasing the budget, even though that is not the purpose of CMI. For political considerations public school educators inevitably ask not is it an efficient information system, but how much does it cost, does it increase achievement and do the teachers and students like it. That is why it is the instructional and curriculum side which is crucial because one can not sell technology alone in a public school setting.

This task is made more difficult because of the origins of most CMI

systems: computer science disciplines and university environments.

In the environment of computer science the human engineering required to allow a terminal operator to use the speed of time sharing is often ignored as one concentrates on the technology of time sharing. Since it is possible because of the ability of the machine to swap jobs in and out in micro seconds, to process an activity in a fraction of the time it takes the user to initiate another activity to be processed, computers in a time sharing mode have reduced, if not eliminated, the constraint of time upon the user. Yet this is only true if the computer does not have to wait upon the terminal operator to sort the information flow coming from the instructional side into manageable units compatible with the input requirements of the information system. This management of information before it gets to the computer is where the game is won or lost, not in the number of I/O's needed or core storage.

Secondly the university origins of these systems make their exportation to public schools look deceptively easy.

The use of individualized, competency-based instruction in a university setting also gives the appearance of abolishing time. The timelessness of this environment is a function not of the speed of the operation but of the institutional leisure provided by a university. The student can operate in an open time frame, contacting the instructor periodically, independent of all other students. He has access on a self-service basis to the resources of a university. The student-teacher ratio is highly variable, and there are a host of intermediary T.A.'s so that 150 students need not be confronted every day by each instructor. Finally, the student can go off on self-motivated, independent study that requires no supervision and which can last for many days, if not weeks. Contact time with the system becomes a random variable with a uniform distribution. Again the system waits upon the user.

What is the situation when one tries to bring a system designed out of the dual environments of the computer and higher education into the world of elementary education where the clock on the wall is absolute dictator? One can no longer have an educational experience where only the structure of the curriculum and the information system need be considered. If only these are considered, what emerges is a standard CMI system which manages education on three levels. The first, the diagnostic level, determines competency and assigns prescriptive activities for reaching mastery. The second, the curricular progress level, determines routes of progress through the curriculum by defining prerequisites and planned pathways. The third level, the evaluation level, manages the curriculum content by test item analysis, statistical inference from population variables and achievement criterion, and prescription effectiveness. Through the use of a well thought out information system such as M.I.C.A. or its progeny, the reporting capability allows the instructor to become a manager of these three areas.

Unfortunately, this alone is a necessary but not a sufficient condition for a successful CMI approach in an elementary school. Two additional realms of management must be addressed by the instructional system: materials management and the management of time, both the teachers' and the students'.

The clock on the wall strikes 11:00 A.M. Math begins and each teacher has only 45 minutes to meet the individual needs of 25 students. One can do nothing before the hour with math and one can do nothing after the hour because the same 25 students must begin other activities in other subject areas.

One cannot buy individualization cheaply by testing and prescribing activities for each student, then hoping he will not return until all other students are served and off pursuing self motivated activities. One cannot afford five terminals, five teacher aides, or five minutes of down time. The setting that must be created is that when a student requires something : assessment, prescriptions, review, planning, quizzing, or tutorial help, it can be offered immediately.

In order to create such an integrated program of compatible instruction, curriculum, and information systems, Madison Public School's Title III effort has been concentrating on developing management structures in seven areas:

1. Curriculum
2. Instructional Sequence
3. Space Allocation
4. Task Allocation
5. Material Acquisition
6. Materials Distribution System
7. Information Structure

The overlapping of these areas creates within the severe constraints of time, money, and space the ability to allow a student to move through the curriculum at his own pace, in his own direction, without any constraints upon his progress. Materials and people are immediately available to the student with a minimum of waiting time.

1. CURRICULUM

Three considerations took precedence in the development of the curriculum; acceptability, technical compatibility, instructional facility. The first was wide spread acceptability of a set of objectives across areas and districts. In order to take advantage of the file sharing capability

of a C.M.I. system, curriculums that can be shared by many schools are essential.

Madison Public School System is fortunate to have had a "multi-year" curriculum effort by the Sherman Elementary School staff in developing an individualized mathematics curriculum which has been adopted by ten other elementary schools in the district. Using this curriculum as the starting point, the second consideration, technical compatability, came to the front. Regardless of the degree of sophistication of the curriculum, one cannot simply wed it to C.M.I. The curriculum must conform to the technical limitations of the information system and must allow the curriculum to take advantage of capabilities provided by the C.M.I. system.

The curriculum of the Sherman Math Program is presently going through a revision effort that will take two summers and cost nearly $20,000. The total number of units must conform to the file management limitations of the system. The number of objectives per unit and the number of prescriptions per objective must conform to the limitations of file space. For the over 300 objectives in the curriculum, 14,000 prescriptions were developed using over 60 texts, all of which have been used within the district in recent years. These prescriptions were classified not only as to which objective and which test they applied, but also as to the type of student and situation for which they would provide optimal help. Seven basic categories were developed including:

1. Best Prescription - This is the preferred prescription to be assigned after the pre-test or post-test A, B or C.

2. Process and Practice - This type of prescription explains the concepts and provides practice exercises.

3. Practice - This type of prescription provides drill exercises.

4. Remedial Process and Practice - This type of prescription explains the concepts in simple terms and provides fairly simple practice exercises.

5. Remedial Practice - This type of prescription provides fairly simple drill exercises.

6. Lab Experience - This type of prescription directs the student to appropriate manipulatives, tapes, etc.

7. Seminar - This prescription assigns the student to the seminar room where he can receive help with a particular problem from a teacher on a one-to-one basis.

These were then built into the prescription file in precise order so that when they are displayed on the screen, their positions indicate to the teacher which type of prescription they are. This means that instead of having to know literally thousands of assignments, teachers need know only eight categories. To make use of the computer's ability to make forward as well as remedial prescriptions, survey units were developed that place students at the beginning of the year into the structure of the curriculum based on where in a survey test they first fail. Review units occur periodically so that students can be rerouted back through material once mastered but not retained. Upon completion of the 60 units in the curriculum, the student takes a post survey test which serves as the measurement tool for year long achievement and retention. Using the prerequisite capabilities of C.M.I. enables the students to be routed on unique pathways through the curriculum. The report making capacity of C.M.I. allows for special units to be added for planning, formative evaluation by teachers and by students, and for profiling student achievement.

Once the curriculum has been defined in a way that is acceptable not only to a broad spectrum of teachers but also to the technical limitations of the C.M.I. system, the third instructional considerations are introduced. In the C.M.I. math curriculum teachers wanted each unit introduced to the student through either a study guide or a study tape, both of which defined the educational objectives of the unit, explained key words, demonstrated how the process was done, and self-tested the student with a typical example. Following this introduction, the student would take a pre-test which included five items for each objective in the unit. To save teacher time, all tests are self-explanatory with detailed instructions. Following the pre-test and the assignment and completion of a prescription, a small three item quiz, developed for each objective, is administered so teachers can determine if the student is ready to take the post-test. In addition to the pre-test there are three post-tests for each unit, as well as a review test which occurs approximately every six units. A series of pre- and post-survey tests were also constructed that cover all objectives in the curriculum. The magnitude of the curriculum effort can be seen by the fact that when completed, 32 test items exist for each objective in the curriculum distributed over seven different testing instruments. For each of these instruments answer books are also printed with each test type color coded and indexed for fast use by aides. The development of such "courseware" which complements the potential of the information system and which provides tools for each instructional purpose is a crucial aspect of C.M.I. development. In fact it is the absense of "courseware", not software or hardware that has limited the spread of CMI to other curriculum areas.

C.M.I. CURRICULUM STRUCTURE

1. SURVEY TEST
2. STUDY QUIDE
   A. INTRODUCTION
   B. PROCESS
   C. SINK OR SWIM
3. PRE TEST
   POST TEST A
   POST TEST B
   POST TEST C
4. QUIZ CARD
5. REVIEW TEST
   PRE REVIEW
   POST REVIEW
6. TEST ANSWER BOOK
7. QUIZ ANSWER BOOK
8. CURRICULUM RATIONALE
9. UNIT PLANNING FORM
10. PRESCRIPTIONS
    BEST FOR EACH TEST
    PROCESS AND PRACTICE
    PRACTICE
    REMEDIAL PROCESS AND PRACTICE
    REMEDIAL PRACTICE
    LAB PACK
    SEMINAR

2. INSTRUCTIONAL SEQUENCE

In developing the instructional sequence of this curriculum it was necessary to determine the points at which teacher intervention, prescriptions and assessment are required by the students. The flow chart on the following page represents the basic stages each student goes through when completing a unit. These basic stages represent implicit tasks that teachers had been doing in the self-contained classroom setting. They involved the teachers in determining answers for the following questions: where should the student begin in the curriculum, what initial experience should be used to introduced the subject matter to each student, how should the student be pre-tested, what remediation should be assigned if mastery was not attained or what new unit should be undertaken if it was attained, was the remedial assignment effective, should the student take a post-test or be given another assignment, and finally, has the student attained mastery on the post-test or must he go through another post-test cycle?

The self contained classroom teacher was making these types of decisions for all students in the group as well as for the group as a whole. The approach used in determining the C.M.I. instructional sequence was to separate these functions, assign only one of the functions to one person on a teaching team, and to determine the sequence of the program through which the student would go at his own pace. Although this model is typical of most I.G.E. instructional plans, its application is unique in that the C.M.I. information system is built right into the model such that at every stage in the instructional sequence the terminal interactively records or retrieves information. The C.M.I. system generates at that instructional station information required by the student before he can proceed to the next station. The C.M.I. system provides a running record of the student's progress not only through the curriculum but also through the instructional sequence within each curriculum unit.

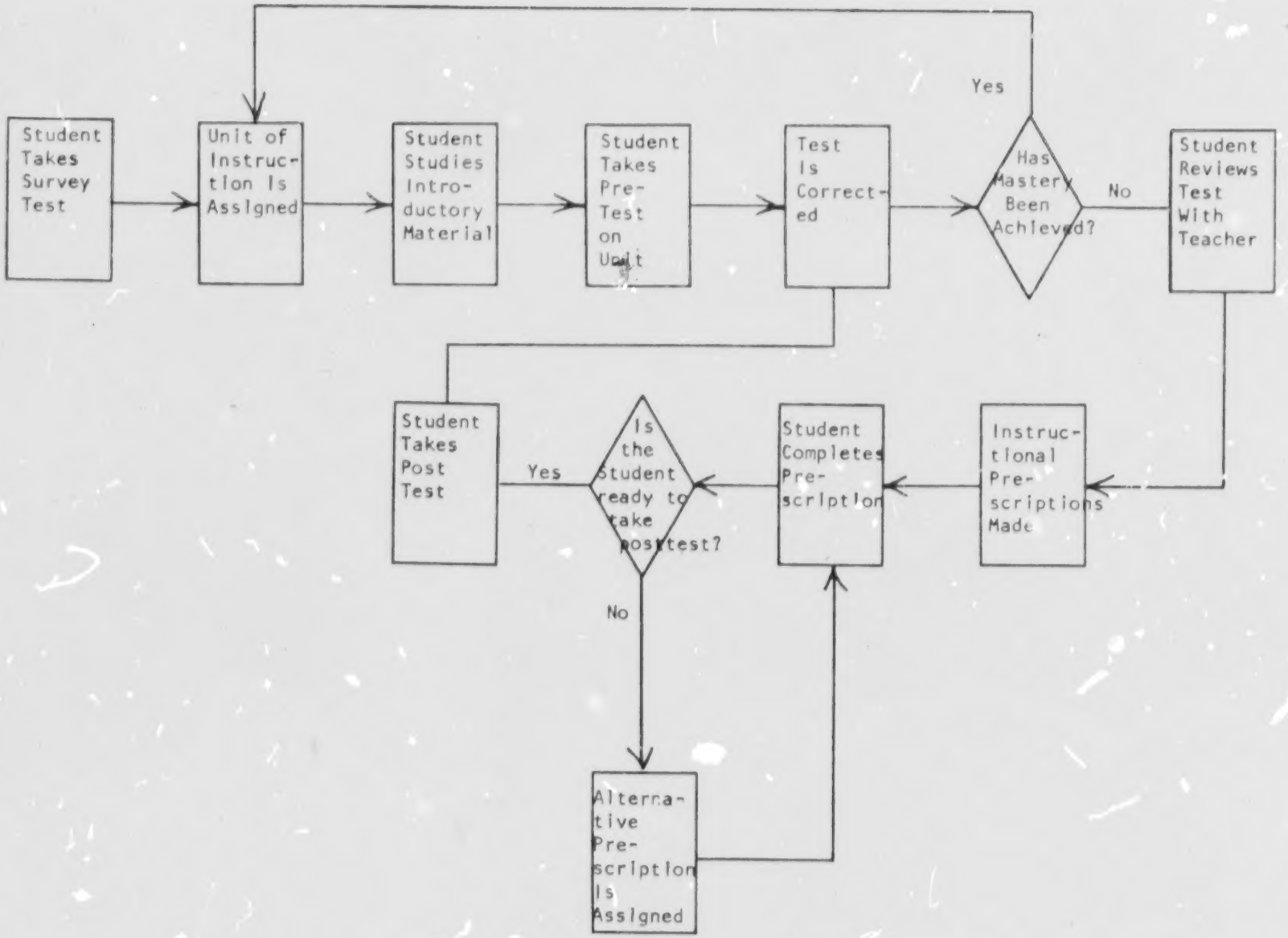


Figure 2. CMI Functional Flow Diagram

3. SPACE ALLOCATION

Once the instructional tasks had been defined, the next management problem was to arrange where these tasks take place so that the number of students in a given room at a given time is reasonable. A clinical model of instruction was adopted in which the student moves from station to station based upon his need for a particular service while the teacher performing that service remains in one place. Division of labor for greater efficiency is the rationale for this model. A teacher in a station is performing only one task; all the courseware tools for that task are close at hand, the time consuming aspects of the self-contained classroom are reduced, and students see a functional reason for being in a given room. The model also provides physical activity during the class hour. Instead of sitting for 50 minutes students are continually on the move going to the testing room, getting a textbook, etc. The difficulty comes in managing the traffic flow between classrooms so that both the volume and the direction of the flow create no disturbances. Within the room, space management is equally important because each student must be able to go about the task without disturbing the other students. Flow patterns within the rooms are arranged so students come in and go out at the edge of the rooms, leaving the center for students engaged in the activity.

The physical buildings which house most elementary schools lend themselves quite well to this type of instruction. One doesn't need large open spaces. Classrooms are sufficient for each task, and the ability to divide rooms into smaller parts is even more important than the ability to create open spaces. The size of each space is a function of the number of students one wants to assign to that space at a given time. The testing rooms are usually the

largest with descending size as one goes through the instructional sequence: study rooms, quiz stations, review stations and seminar stations. The one technical requirement is that some area be designated for the terminal operator that is closed off from through traffic patterns because of the dust effect on the terminal. This room must have access to a phone with a preconditioned line and grounded outlets. At Sherman we have been using a teacher aide's work room with a Dutch door so that the paper transfers come in and out without the students physically coming into the terminal room. This keeps the dust volume down and the interferences of traffic away from the terminal operator.

At Sherman there is a very large testing room which will hold up to sixty students at a time. This room is segmented so that the review teacher also has one corner of the room away from the students who are either taking tests or waiting for their tests to be corrected. Three standard classrooms have been designated as study rooms where students work on their assignments. Students can be assigned to a given study room, they can select study rooms randomly, or the rooms can be designated by units such that room 28 would be for students with fractions, 29 for those working with sets, 27 for those working with addition and subtraction, etc. Another standard sized room is used as a quiz room where students go after having completed all assignments to see if they need additional assignments or if they are ready to take the next post-test. The last classroom in the system is used both as a seminar room and as a room for the math lab equipment.

COMPUTER
MANAGED
INSTRUCTIONAL
SYSTEM
Students
1.Curriculum
2.Software
3.Hardware
4.Roles and Processes

4. TASK ALLOCATION

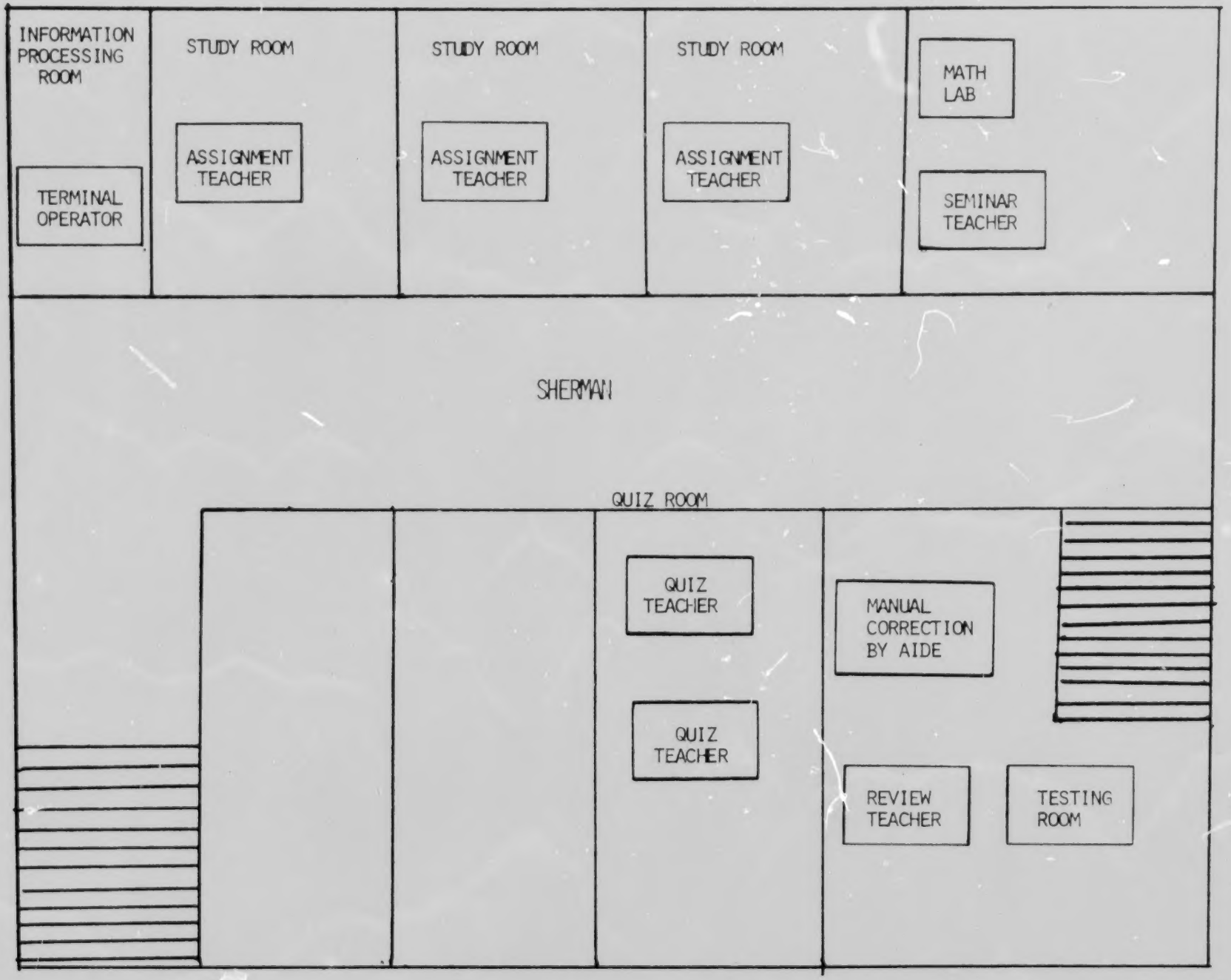
A central reality facing elementary schools is declining enrollment and the retention of inflexible student/teacher ratios for determining teacher allocation. The total number of teachers available to team is the most serious constraint on the instructional model. In order to have efficeint division of labor, one must not only specify what tasks are to be performed but also which people are to perform these tasks and how many are to be allocated to a given task. The resource people available to elementary schools include not only aides but also students and parent volunteers. The scarcity of these resource people is a function not only of the cost per hour but also of the institutional agreements the school has entered into with the teachers' union. This has defined not only how many teachers will be available, but also what kinds of tasks teachers, aides, and parents can perform.

The C.M.I. task system is based on setting resources in an availability priority from the most numerous students, to those whose time one wants most to protect, teachers. All tasks that have to be done are assigned on an inquiry sequence. The most trivial tasks such as getting and distributing materials are assigned to the students themselves. We have found that a large proportion of teacher time was taken up with "where" questions: where is the right book, where is the right test, where do I go, etc. Students are either taught to answer these questions themselves or to seek student help from helpers who are selected on a rotating basis to handle tasks such as taking assignments to the study rooms or finding appropriate texts on the shelves. Many questions are basically parental in nature if they are behavioral, and clerical in nature if they are instructional. For example,"what should I do now," or "what did I get wrong on the test?" Parents can be used to supervise

the test room, set up math games and equipment in the math labs, answer reading questions on the tests, etc. If parent volunteers are available, it would be inefficient to waste teachers time in paternalistic functions that require no professional skills.

The role of teacher aides is to take over all clerical responsibilities from the teachers. In Madison's C.M.I. project teacher aides operate the terminal so that both the C.M.I. information system and the aides perform the grading of tests, input of information into the system, generation of reports, and providing the students with the courseware required. Aides make no instructional decisions as the C.M.I. system has either previously embodied teacher decisions or gives the teacher decision power which the aide merely records once the decision has been made. Teachers are no longer graders, scribes, filers, or retrievers of information. No manual records are kept nor mountains of paper work required. All pertinent information is recorded at the terminal. At Sherman the aides perform the tasks of grading tests and operating the terminal. Next year through the use of the optical scan reader both of these functions can be combined which will free one instructional aide to help in the study rooms and with the quiz function. Aides and the C.M.I. function answer the "what" questions generated by individualized instruction, for example, "what did I miss on the test?"

The role of the teachers is to answer the more important questions: the "why" and the "how" questions. The teacher acting in the role of study teacher helps students develop the skills required to master the concepts and problems. The quiz teacher teacher determines if students are ready for a post-test and what types of assignments meet the needs of each person. The quiz teacher also specifies additional assignments for each student if he determines that the initial remediation effort was


INFORMATION PROCESSING ROOM
TERMINAL OPERATOR
STUDY ROOM
ASSIGNMENT TEACHER
STUDY ROOM
ASSIGNMENT TEACHER
STUDY ROOM
ASSIGNMENT TEACHER
MATH LAB
SEMINAR TEACHER
SHERMAN
QUIZ ROOM
QUIZ TEACHER
QUIZ TEACHER
MANUAL CORRECTION BY AIDE
REVIEW TEACHER
TESTING ROOM

unsuccessful. The review teacher works on a one-to-one basis with the student in order to explain the concepts missed on the test or to congratulate success. The final role performed by teachers is that of the seminar teacher who is free to spend time solving particular learning problems that cannot be solved in the normal instructional sequence. The report capability of the C.M.I. system allows the seminar teacher to identify students working on the same topic for the purpose of small group instruction.

The last task allocation question is how many people should perform each function. This is determined by trial and experimentation with the purpose of minimizing the waiting time at each function. Once the system is in operation the length of time required to process each student at each station tends to regularize. At this point queue analysis can be done to determine the optimal number of persons required to perform the function so as to reduce waiting time to a few minutes. Currently at Sherman three teachers are assigned to the study rooms, one teacher is reviewing, one teacher is in seminar and two teachers are administering quizzes.

This management device approach is just a process whereby the more variations possible, the closer one can come to an optimal solution. The one major restriction we have found in regard to task allocation is that very small schools with only three or four teachers available for teaming have proven to be less efficient than larger schools, even if the smaller schools had lower student - teacher ratios.

5. MATERIAL ACQUISITIONS

In the elementary environment where the total resources to which the student has access are usually only inhouse materials, the problem of material development becomes important. One cannot rely on vast I.M.C.'s or resource centers. How is a school using a C.M.I. curriculum which can handle thousands of prescriptions from hundreds of sources from a technical view point to afford and display such a variety of materials? Currently the math curriculum uses over 60 different types of books. Instead of buying a class set of a given textbook the school can get by with five copies of each, if, in the planning of the prescription file, the assignments for each unit are spread through the entire series of texts such that the probability of seventy students needing one particular text at one time is very remote. Systematic prescription building based upon the knowledge that students will be spread through out the curriculum makes feasible a multi-text approach. Optional assignments provide the aide with alternatives from which to choose if one text is out at a given moment.

The same concept applies to math lab materials. Currently one multi-media experience has been found or designed for each objective in the curriculum. Only one set exists based again on the low probability that two students will arrive simultaneously in the lab requiring the same experience. Multiple listening centers enable more than one student to use the audio tapes at the same time if the need arises.

When implementing a C.M.I. approach in a school system in which each school has its own unique set of materials and its own perceptions about the relative merits of each text, flexibility is crucial. The C.M.I. information system provides a procedure for gradually building up ones

resources to match the total set of prescriptions available. A master set of assignments are identified from all supported textbooks within the district. They are identified as to which curriculum objective they relate, the type of educational task they perform, and the precise book, edition, page and problem to which they refer. Simultaneously materials inventories are done in the participating schools in which the type and number of each resource on the master list are identified, and from that a school inventory file is constructed.

At this point one of two routes may be taken. Immediate materials discrepancies can be identified, and if the fiscal resources are available, complete sets of resources can be built up so that each school has the same resource base as the master set. The number of copies of each textbook would be determined as a percentage of total number of students in the program. Findings from the schools currently using the program indicate that this percentage will fall between 5% and 20%. This process is a very static and costly way to gear up for C.M.I., especially when a district may be supporting a great many different texts.

A much more rationale approach is to use the C.M.I. capabilities for not only a dynamic assessment of purchases, but also for the dynamic management of those resources within the instructional hour. In the final Title III version of C.M.I. there will be a master prescription file that is comprehensive district wide within a subject area. Each school will have an inventory file where the resources currently available to each school are listed. The computer program creates a unique prescription file for each school whereby all of the prescriptions on the master file are searched to see if one exists for each objective and each type of prescription within the limited sets of texts available in that school.

A hardcopy print out of each school's prescription potential can then be made. If gaps appear in the prescriptions indicating that the school has no materials for that objective or that type of prescription, various hypothetical purchases can be simulated to show which purchase fills the greatest number of gaps and the minimum number of text types that must be acquired to assure curriculum continuity.

One can also generate counts as to the number of prescriptions that can be made from a given text so that priorities can be set concerning which texts will be supported by the district in the future. Those texts that contain the fewest number of objectives unless they pertain to a unique section of the curriculum can be deleted in favor of those which are most applicable to the curriculum. In this way a variety of texts can be managed without supporting hundreds of rarely used editions or forcing one or two approaches in order to supply prescriptions for all segments and purposes within the curriculum.

We are planning now the final version of the program which will track texts prescribed from so that when 20 prescriptions have been made out of a given text when only 21 books are available within the school, the prescription file deletes all prescriptions from that text for the rest of the session and dynamically rebuilds replacements out of the master file that correspond to texts still available in the school. In this way the management of materials is done automatically and the need for additional copies for a given text can be identified. This is especially important in terms of the local options available to each school of selecting only those units out of the master curriculum that they wish to teach.

Hopefully this system will allow the process of text book selection to be based on content analysis. When a new book or new materials appear

on the market, curriculum committees of teachers search for all possible prescriptions that meet their quality criteria. These are added to the master prescription file where their relative productivity can be judged.

6. MATERIAL DISTRIBUTION SYSTEM

The economic rationale behind this clinical model is that the services are provided at each location in the fastest and most economically efficient manner. If materials are to be handed out, it is cheaper to have an aide do it rather than a teacher, a parent rather than an aide, a student rather than a parent, and a piece of walnut rather than a student. It is absurd to pay teachers to spend all of their time handing out tests, textbooks, etc. when this function can be made a self-service operation where the proper selection, placement, labeling and display of furniture allows the student to get his or her own material. It is much like a self-service department where no labor is wasted in material handling.

The problem arises only because the vast volume of material created by an individualized curriculum forces the allocation of teachers and aides as full time material handlers. The Sherman curriculum has sixty units, over 300 objectives, 240 different tests, over 300 multi/ media or math lab experiences, 200 sets of quiz cards, and multi-copies of nearly 60 different texts, workbooks, exercises, etc. Having observed schools using this curriculum, I have found it not uncommon to see one or two teachers out of a team of seven spending all of their time distributing materials. Based on the real wage per instructional hour of over $10 per teacher, 15¢ worth of labor was being used for 3¢ worth of paper when 1¢ spent on appropriate furniture would have paid for the most elaborate equipment one could purchase in one year.

Secondly, handing papers out by hand is slow; students wait in long lines while aides dig through filing cabinets bursting with manila folders. Pulling out one test means opening a drawer with 1000 test copies, all of which have to be shifted. Students can't do it because they would have to know the filing system, be careful not to disrupt the order of folders, and be six feet tall to reach to the back of the top file. Unfortunately, there are few fourth graders who meet these criteria.

Thirdly, chaos results in the traditional stacking or shelving of small items. In the past, games, film strips, cassettes were placed out on tables or put into cabinets. At the end of the hour nothing could be found; it took one hour to reshelve the items, and throughout the year many items were lost or damaged in the process of shoving them back into place. Knowing what was available at any given time was impossible.

For the computer school, all recordkeeping is done within the information system of the computer, and only the various outputs, batch and interactive, need to be handled. Yet most teachers have only one place to store terminal hardcopy which comes out in a continuous roll -- the chalk rack and with a rubber band. Batch output on large size computer printout paper is useless because of its size (too large for either file cabinets or desks). Without proper binders it is easily torn and is hard to handle.

Without special furniture what are the results? Teachers do not use the information provided by individualization and crucial for the proper management of individualization. They don't use it because they have no place to put it and no way to retrieve it even if they could store it. Its useless, not because of the quality of the content, but because of the quantity and form. I have observed other projects where teachers were recopying reports from hardcopy into grade books or 3 x 5 cards and then throwing the hardcopy away because it wouldn't fit in the desk. When you are dealing with a system that generates and handles 7 million words during one semester, the minute one stops

to recopy by hand one is dead.

The design specification behind the furniture system was that all instructional materials to be accessed and used by students during the instructional hour be self-service. They must be clearly visible and labelled with the same achronym that appears on the computer printout. A student must be able to get one piece of instructional material -- a test, quiz card, study guide, or lab pack without disturbing the order of any other piece of material. The materials must be as easy to put back in the right spot as to get out initially. An aide must be able to assess on inspection the need for more materials and quickly restock a particular item from a back up supply without having to rearrange other materials. Lastly, as the curriculum is revised the actual instructional materials can be changed without having to rearrange or re-label the furniture and materials distribution system. Basically, it is a modular design where one has a basic piece of furniture (bookcase, music folio, steel shelving, etc.) which can be compartmentalized. The compartments, usually open or closed cardboard filers or boxes, can easily be labelled as to what is inside. These compartments can then be arranged sequentially to parallel the structure of the curriculum. Into each compartment can then be put either single or multi-sets of durable materials such as study guides, lab packs, quiz cards, etc. or multiple copies of consumable tests or test answer sheets.

This instructional system allows a student working at his own pace to be given a task to do by a teacher with precise instructions clearly stated on a computer printout. The student can then go without assistance to the furniture item holding that type of material, find the compartment with a label corresponding to the printout achronym, and remove one copy of the needed material. If it is a durable, the student replaces it after it has been used; if it is a consumable, an aide can restock when the supply gets low.

The best example of this system is the test system. Students are spread out in achievement from Unit 1 to Unit 60 based on when they entered the program and their rate of attainment. Within each unit, some students are on the pre-test while others are on one of the three post-tests. This means that at any time during an hour students may be withdrawing any one of 240 different tests. During the course of the year a student will consume approximately 70 tests. Based on past experience, one knows the probability of a student needing a given test during the year; this makes it possible to print just enough tests to meet the expected needs of the students. In fact, MICA has a test item report which provides jsut such information. For example, using a student population of 140, one will need for Unit 5 160 copies of the pre-test (this includes students reassigned to the unit), 120 copies of post-test A, 80 copies of post-test B, and 20 copies of post-test C. On any given day, however, one needs only a fraction of these tests displayed. Therefore, instead of stacking up 160 tests so that five students can get a copy, Madison has been using music folio cabinets, each of which hold 25 copies of 90 different tests. In this way a minimum amount of space allows the entire curriculum to be displayed. These folios are kept in the testing room and have doors which can be locked at the end of the math hour. In a storage room are steel shelves filled with four high cardboard filers, one for each unit in the curriculum. Here the reserve tests are kept, clearly labelled, so that as compartments of the folio are emptied, an aide or student can in minutes be sent to the supply room for 25 more copies. The same principle is used for the storage of study guides, quiz cards, lab materials, textbooks, and answer books. Study guides and text books are stored in the terminal room

so that as assignments are generated, student helpers can take the tear off assignment sheet to a large set of bookcases, get the needed book, and send it to the student in a pre-assigned study room. In each study room a set of answer books is kept for every text used in the curriculum as well as a set of quiz cards. In the lab room is a lab pack box for each objective in the curriculum, a tape for each study guide, and the multi-media equipment needed. To aid in handling the output of either the terminal or the batch report, we have tried to supply the terminal aide and the teachers with various types of data storing devices typically used in business operations which handle a large volume of information. In this way we hope to prevent information requested by teachers from ultimately being buried at the bottom of a desk drawer. Our primary concern behind all of this is that teachers not have to worry about the material handling aspect of individualization.

7. Information System

This part of the paper is a segment of the User Manual for MICA level 4. It is a combination of three previous papers which have been prepared since the inception of the software design in 1972. Professor Frank B. Baker, Laboratory of Experimental Design, University of Wisconsin, began the initial documentation and systems development. This effort continued by a group of graduate students resulted in the following paper:

MANAGED INSTRUCTION WITH COMPUTER ASSISTANCE

(MICA)

System Overview

Prepared by

George Behr
John Berg
Stuart Jacobs
Richard Le Faivre
Nathan Relles
Joe Underwood

for

Professor Frank B. Baker
Educational Psychology 892
University of Wisconsin
May, 1972

This system was used to support an experiment in computer managed instruction during the School year 1973 - 1974 at Sherman Elementary School in Madison. As a result of that experiment various aspects of the design were changed to meet the educational needs of the program at Sherman. The results of those changes made primarily by Tom Lorenz under the supervision of Dr. Baker were documented in a revised version of the original paper with the same title with the postscript.

REVISED AND IMPLEMENTED

by

Thomas B. Lorenz
John Chapin

June, 1974

The first part of that document is reprinted in section I in the current systems document. The user's manual at the end is a further revision reflecting the changes embodied during the first semester of the school year 1974 - 1975. As of July 1, 1974 E.S.E.A. Title III undertook the funding of this program and Mr. Lorenz began work for the Madison Public Schools, which has assumed responsibility for software development during the life of the project. The User Manual, completed during February 1975, reflects only the system that is in operation this year as next year the next software version, Level 5, will be in operation with multi school and multi curriculum capability. Periodically, for each level of subsequent development Research and Development will publish a documented systems overview to aid not only in the dissemination of this approach to supporting education with technology, but also to give a continuous record of that software development effort.

The information system which will be described in the following pages of the USER'S MANUAL M.I.C.A. LEVEL 4 serves an educational purpose,only because it was designed and revised in conjunction with the curriculum,instructional process, and the material management systems.Its utility is that it binds together the other systems with the information it channels,records, and retrieves.It drives the instructional hour because the information system processes data interactively while the hour proceeds.Without it continually recording and retrieving information student's can not proceed and teachers can not easily make instructional decisions.This is why the interactive capability of the system has been stressed.Prior to this system a teacher interpreted test results,recorded them manually,search multi texts for appropriate prescriptions,wrote out the selected assignment on a student card along with directions on where the student was to go next,and then noted on a class progress chart the position of the student in the curriculum.This process took between three and four minutes.Unfortunately ,students were coming to the teacher at the rate of one per minute because of the speed at which students were working through this individualized curriculum.The students were waiting on the information system.With M.I.C.A. level 4 and its allied instructional and material handling systems this process now takes between 30 seconds to one minute and the information system now waits on the student.M.I.C.A. alone in its earlier version without such a total management approach could never get the process below two minutes.

The reports and capabilities of M.I.C.A. in its present version allows the teacher to be a manager of information on five levels.On the diagnostic level the system allows the recording of test information(/P) ,the generation of prescriptions,and the updating of alternative assignments(/A).On the level of student progress,the system can be used to plan a students route of progress or to intervene at any point in assigning the student a new unit(/ 0).In order

to help a teacher make such plans or interventions the system enables the teacher to retrieve(S) a student history report on either the current unit the student is on or a complete record of student accomplishments and assignments from some point in time.On this same level a contact report(C) can be used to find students who have not participated in an interaction for a given length of time.In this same manner a group report can be generated(G) which lists out for each home room teacher where each student in his or her homeroom is within the structure of the curriculum.On the instructional level teachers can call for a unit report(U) which sorts students according to which unit within the curriculum they are working on .The identity of all students on a particular unit or for all units in the curriculum can be called for.This is used in forming small groups and seminars.The next level of information handling is that of parental communication whereby the teacher can get a unit achievement report(L) which prints out for the parents of a student the units accomplished,the number of days and dates of the unit,the number of tests taken to gain mastery,and how the student compares with the average student in a given grade.A

All of these reports are generated interactively apon demand during the instructional hour when the teacher needs the information.A student returns to class from an illness and a current unit report is generated so they can begin where they left off immediately.A student is having trouble with fractions so the teacher asks for a student history report that covers a previous unit on fractions to see if the problem is new or a continuation of a prior problem.A teacher wants to know if a particular student and some friends have been spending too much time between assignments,so a contact report is generated.A parent comes in for a conferance on short notice and a teacher can generate a listing of unit achievement right on the spot.A principal wants to know how some students are doing so a group report is generated.Finally some open space appears in the schedule and a unit report is generated to see if enough students are on a particular unit to justify a seminar.This is why the system is interactive.

MICA Software Components

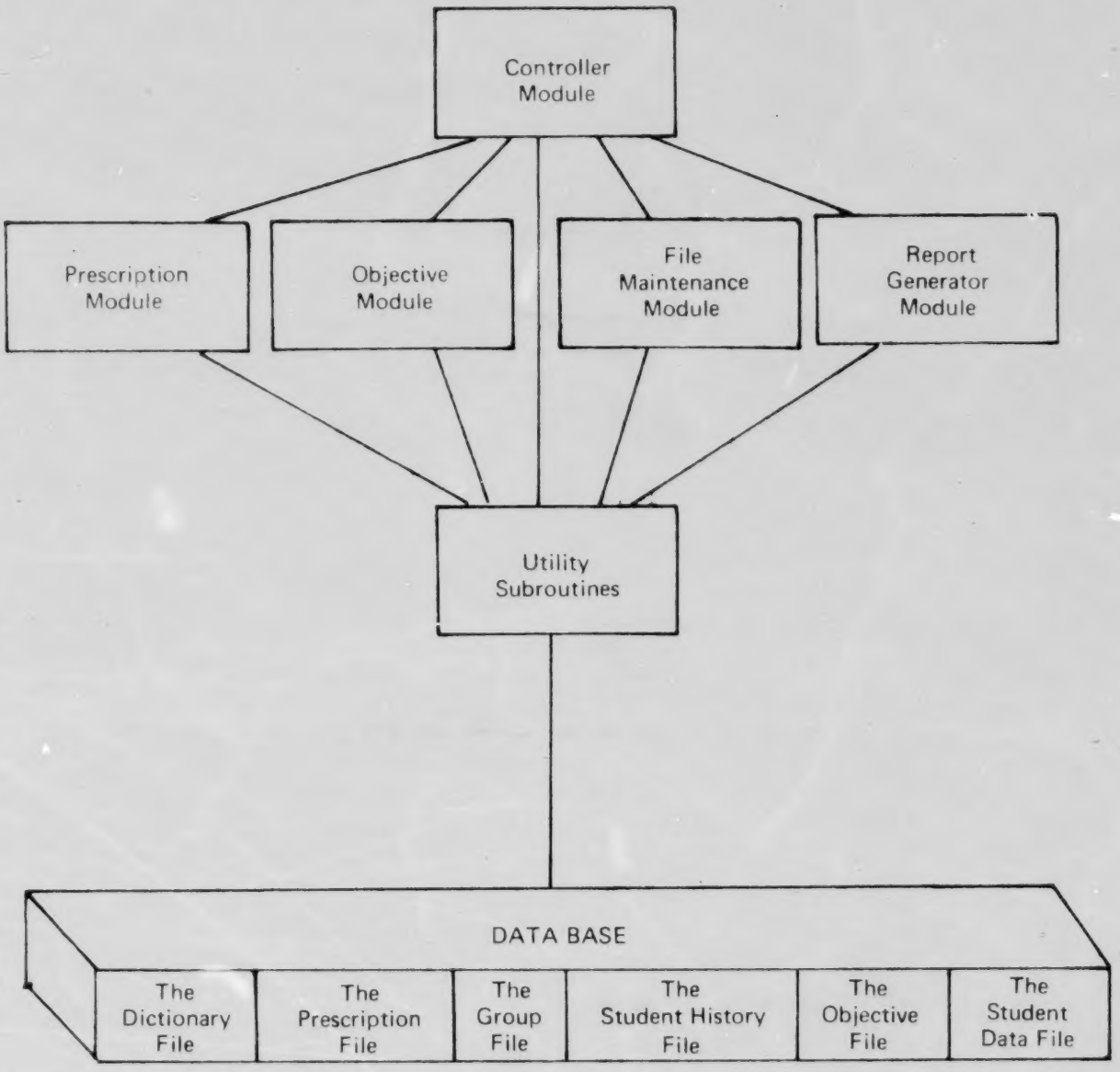


FIGURE 3

Communicating With MICA

MICA provides three major transaction modules referred to as the unit, prescription, and report modules. The unit module allows the user to select a unit of study, instructional method, and pretest. After a student has taken a test, the prescription module accepts the results of the test and, based on the results, prints a menu of forward or remedial prescription alternatives. If remedial prescriptions are selected, the user also chooses from a menu of post-test alternatives. The report module allows the user to receive any of the interactive MICA reports. MICA also provides a service module which allows the user to perform various housekeeping functions. Instructions needed to access the various modules follow.

The MICA program is organized into a hierarchy of modules. The master module, the one that controls all the others (the slaves), is called the controller. Whenever the controller takes command, it prints MICA READY. The controller takes command when it is called to do so or when a slave completes its task. The slaves under the controller are the service, unit, prescription, and report modules. To tell the controller we want to use one of the slave modules, we type a MICA control statement. The control statement has a slash as the first character and a letter as the second character. The second letter specifies which slave module the controller is to call into action. Additional information may be typed following the 2nd character, depending on the module called. When a slave module is performing a task, the task should not be interrupted by typing in a new MICA control statement until the slave prompts the user to respond. An explanation of each of the MICA control statements follows.

COMMENT

//text

The double slash command is used to record comments or notes. For example, the quiz teacher could request the terminal operator to add a reminder to the student at the bottom of his tear-off sheet. Another use of this command is to send a message to the data base manager for correction of misspelled words in the data base and the requesting of the printing of very large reports.

The double slash command may be typed any time the terminal operator is prompted to type information, select from a menu, or call a module. Once the message is typed, the terminal operator continues the task by responding to the original prompt.

Examples

```
// JIM BARLOW # 148  HIS NAME IS SPELLED INCORRECTLY
// REPORT PLS:  S,MS GRASS,5/9/74,3G
```

CONTROLLER

/C

The /C command calls the controller. It can be used to interrupt a transaction when it is discovered that the transaction is in error. Typing /C (R) can be done at any point during the transaction when the computer prompts information from the operator. After the /C (R) is typed and the computer responds with MICA READY, the transaction is ended and will not appear on the student's record. If the /C (R) is typed after the transaction is completed (i.e., after the computer responds with PRESCRIPTION or UNIT SELECTION COMPLETE MICA READY), however, the /C (R) will have no effect in removing the transaction from the student's record.

Following this command the controller resumes control and prints MICA READY in response.

Example

```
MICA READY
/P,17(R)
?ENTER TB 6-1 RESULTS FOR SCHMIDT REBECCA          HR 24 MS PIERCE
/C(R)
MICA READY
```

Explanation: The /C was typed because the wrong student number was entered or the student took the wrong test.

UNIT ASSIGNMENT

/O,id#

The /O command calls the Unit Module which is used to assign an instructional unit to a student. /O is typed, followed by the student's ID number and a carriage return. The MICA program prints the student's name as a validity check and prompts the typing of the unit's name. If the unit has prerequisites which the student has not met, the prerequisites are printed in menu fashion and the selection of one of them is prompted. A prerequisite is chosen by typing the number to the left of it. Prerequisites are ignored and the originally typed unit is assigned the student by typing a carriage return. When the assignment of the unit is resolved, a menu of methods for studying the unit is presented to choose from. The selection of the method is followed by a menu of pre-tests from which to choose. The selection of the pre-test completes the transaction. The program then prints a summary of the unit assignment which is given to the student.

Note: The command uses the letter o, not the number zero.

Example 1 - The Unit Module is called for student number 136, John Chapin. The third review unit is assigned to him. John has not been assigned UNIT 8 which is a prerequisite. The prerequisite is ignored and REVIEW 3 is assigned by typing a carriage return after MICA prints ?UNIT #. Only one method is available, so MICA automatically assigns it. A pre-test is chosen from the menu of pre-tests available within the method. A summary of the transaction is printed by MICA and control is returned to the Controller.

```
/0,136 (R)
 ENTER UNIT ASSIGNMENT FOR CHAPIN JOHN
REVIEW 3(R)
 ?PREREQUISITE UNITS:
 ? 1. UNIT 8
 ?UNIT #
(R)
 ONLY ONE METHOD IS AVAILABLE: TEST

 ?AVAILABLE PRE-TESTS:
 ? 1. R3-PRA
 ? 2. R3-PRC

 ?TEST #
2(R)

NAME                    DATE        UNIT          METHOD          TEST

CHAPIN JOHN      11/09/74        REVIEW 3      TEST            R3-PRC
 136


UNIT SELECTION COMPLETE
MICA READY
```

PRESCRIPTION

/P,id#mode

Use the /P command to call the Prescription Module. The Prescription Module assigns remedial studies or more advanced units to the student depending on the test results that are entered. There are two modes of operation; normal and fast. The normal mode will be discussed first. The modifications resulting in the fast mode of operation are explained following the discussion of the normal mode.

The Prescription Module is called and the student's name is displayed as a validity check. The typing of the student's test results is prompted. The terminal operator types the test item numbers of those items the student answered incorrectly. The item numbers are separated by commas and followed by a period. Just a period is typed if the student had no errors. At this point the transaction takes one of two courses, depending on whether the student is to continue working on his present unit or is to be assigned a new one.

1. When the student is to continue working on his present unit, a list of remedial prescriptions is printed. The list is composed of a set of eight prescriptions for each item the student missed. The first prescription is the title of the item. The second is the "best" prescription as a first remedial exercise. The remaining prescriptions are various types of remedial exercises which can be assigned in addition to the best prescription by the quiz teacher. The physical position of the prescription in the set of eight is determined by the type of prescription it is.

Types three through eight are the following:

3. Process and practice
4. Practice
5. Remedial process and practice
6. Remedial practice
7. Multi-media lab
8. Seminar

The terminal operator is prompted to assign the activities for the student. The terminal operator may take one of two actions:

a. Type a carriage return which automatically assigns to the student the best prescription from each set printed.

b. Type the numbers of the prescriptions that the student is to study. The numbers are entered in pairs with the first number being the number of the title and the second being that of the actual assignment. These two numbers are separated by a comma and followed by a period.

After the activities are selected, a menu of post-tests is printed, and the terminal operator is prompted to choose one by typing its number. The selection of the post-test ends the transaction and control reverts to the Controller.

2. When the student has mastered the unit assigned him, a menu of more advanced units is printed. The terminal operator is prompted to select a new unit for the student. The terminal operator types the number of the selected unit. At this point in the transaction the computer program automatically transfers control to the Unit Module which handles the assignment of the selected unit.

The fast mode of operation is accomplished by modifying the call of the prescription module. Instead of using the student's ID number followed by a carriage return, the ID number is followed by an F and then a carriage return. The fast mode is the same as the normal mode except that the menu of remedial prescriptions is omitted.

Example 1 - Misses objectives - slow mode - select best or pairs

The student misses one or more objectives. The terminal operator using the slow mode (all possible prescriptions for each objective missed are displayed) chooses the best prescription, generally, or pairs of prescriptions by typing the numbers to the left of those chosen.

```
MICA READY
/P,136 ®
 ?ENTER PR13-1 RESULTS FOR CHAPIN JOHN        HR 26 MS GRASS
1,3,4 ®
 ?REMEDIAL PRESCRIPTIONS:
    ?1253. MULT: 1 PL x 5                ?1273. EA(4) P.247 PROB(6)
    ?1254. MSM4 P.226 PROB.(11-30)       ?1274. EM(6) P.41 PROB(14-15)
    ?1255. M(4) P116-117(WRITTEN 1-7     ?1275. EM(5) P.333(SET28,POW2-3
    ?1256. CSDK CARDS MULT 7,13          ?1276. SEMINAR 15(3)
    ?1257. EMMD P.200,201BOTTOM A-D      ?1277. DIV OF HUN: 10S-100S G/R
    ?1258. MS OF A P.50 (SET 111)        ?1278. ESM5 P123
    ?1259. MSM(4) REV P.224              ?1279. EA(5) P.109 PROB(4-9)
    ?1260. SEMINAR 13(1)                 ?1280. NDM(4) P.333(SET 54,3-6)
    ?1269  MULT: 2 PL x 3 PL WITH Ø      ?1281. MSM WB(3) P.112(1-6)
    ?1270  MSOFA P.92                    ?1282. EA(4) P.244 PROB (1-7)
    ?1271  EA(5) P.69(1-3),186(2-3)      ?1283. MEMR(6) P.11 PROB(17-28)
    ?1272. CSDK CARDS MULT 22,23         ?1284. SEMINAR 13(4)

 ?ACTIVITY #
®
 ?AVAILABLE POST-TESTS:
 ?  1. TA13-1
 ?  2. TB13-1
 ?  3. TC13-1

 ?TEST #
1®

 NAME                  DATE          UNIT              METHOD        TEST

 CHAPIN JOHN       11/13/74          UNIT 13-1         STG. 13       TA13-1

 STUDY LIST
     MULT: 1 PL x 5                  MSM4 P.226 PROB.(11-30)
     MULT: 2 PL x 3 PL WITH Ø        MSOFA P.92
     DIV OF HUN: 10S-100S Q/R        ESM5 P123
 136
```

The student did not achieve mastery of objectives 1,3, and 4 in test PR13-1. A menu of three sets of prescriptions is printed and the operator is prompted to make a selection. The best prescriptions are chosen by typing a carriage return. A post-test is selected by the terminal operator and a summary of the transaction is printed for the student before control is returned to the Controller.

The terminal operator types:

a. /P,student identification number and carriage return

b. Numbers of objectives missed separated by commas and followed by a period and carriage return. If the period is forgotten, the computer answers with ?ENTER THE REMAINING RESULTS AND A PERIOD. If all missed objectives have been correctly entered, type a period and carriage return.

c. Carriage return for the best prescription or pairs of numbers of the prescriptions chosen followed by a carriage return

d. 1,2 or 3 for the appropriate post-test followed by a carriage return

Example 2 - Passes

The student passes (misses no objectives). No list of possible prescriptions is shown since the student advances to the next unit.

```
/P136 (R)
 ?ENTER R3-PRC RESULTS FOR CHAPIN JOHN                    HR 26 MS GRASS
.(R)
 ?NEXT UNITS;
 ? 1. UNIT 13-1
 ?UNIT #
1 (R)

 CHAPIN JOHN        11/09/74

 PRESCRIPTION SELECTION COMPLETED.

 ?AVAILABLE METHODS:
 ? 1. STG. 13
 ? 2. STUDY TAPE

 ?METHOD #
1(R)
 ONLY ONE PRETEST IS AVAILABLE: PR13-1

 NAME                DATE        UNIT                METHOD          TEST

 CHAPIN JOHN        11/09/74     UNIT 13-1           STG. 13         PR13-1
  136


 UNIT SELECTION COMPLETE
 MICA READY
```

The terminal operator types:
a. /P,student identification and carriage return
b. A period to indicate no objectives were missed followed by a carriage return.
c. 1 for the next unit followed by a carriage return
d. 1 or 2 for the method followed by a carriage return

In this example the student has demonstrated mastery of the tested objectives. The terminal operator types a period followed by a carriage return to record mastery in the student's record. MICA prints a menu of new units for the student to study. In this case only one unit is in the menu. MICA does not automatically select a unit when only one is included in the menu because, once a unit is selected, the prescription part of the transaction is complete. Thus the terminal operator, before selecting the unit, has one last chance to check the results entered for typing errors. The unit is selected and the Unit Module is automatically called to complete the assignment of the unit.

Example 3 - Misses objectives - fast mode - select by type.

The student misses one or more objectives. The terminal operator using the fast mode (display of all possible prescriptions bypassed) chooses the best prescription, generally, or another type for all objectives missed.

```
 MICA READY
/P,136F®
 ?ENTER TA13-1 RESULTS FOR CHAPIN JOHN                    HR 26 MS GRASS
3.®
 ?REMEDIAL PRESCRIPTIONS:

 ?ACTIVITY #
3.®
 ?AVAILABLE POST-TESTS:
 ?  1. TA13-1
 ?  2. TB13-1
 ?  3. TC13-1

 ?TEST #
2®

  NAME              DATE       UNIT              METHOD          TEST

  CHAPIN JOHN       11/13/74   UNIT 13-1         STG. 13         TB13-1

  STUDY LIST
     MULT: 2 PL x 3 PL WITH Ø   CSDK CARDS MULT 22,23
   136


  PRESCRIPTION SELECTION COMPLETED.
  MICA READY
```

The terminal operator types:

a. /P,student identification number followed by F and a carriage return
b. Numbers of objectives missed separated by commas and followed by a period and carriage return
c. Carriage return for the best prescription or 3, 4, 5, 6, 7 or 8 for another type of prescription followed by a carriage return
d. 1, 2 or 3 for the appropriate post-test followed by a carriage return

This is an example of the fast mode of prescription. Note that an F follows the student ID number and the menu of prescriptions is missing. Note also that the prescriptions are chosen by typing the number which indicates the relative position in the set of eight prescriptions of the prescription type wanted. If there had been two objectives missed, then the third prescription of each set would have been assigned.

Example 4 - Misses objectives - slow mode - combination of best and alternate assignments.

The student misses one or more objectives. The terminal operator, using the slow mode, chooses a combination of best and alternate assignments through pairing the computer number of each objective title with the computer number of an individual assignment.

```
/P,5®
 ?ENTER PR12-1 RESULTS FOR BURSE DEBBIE      HR 24 MS PIERCE
1,2,3,4.®
 ?REMEDIAL PRESCRIPTIONS:
    ? 929. FACTORS                      ? 945. MULTIPLES
    ? 930. MSM(3) P.230,231             ? 946. MSM(4) P. 194
    ? 931. MSMR(4) P.25                 ? 947. MSM(3) P. 224(1-6,13-23)
    ? 932. MSMWB(3) P.75                ? 948. MSMD(4) P.53
    ? 933. MSMR(5) P.25                 ? 949. EEM(5) P.125,126 (6-8)
    ? 934. M(4) P.155 PROB(ORAL1-5)     ? 950. MSMR(4) P.24 PROB(1-6)
    ? 935. LAB PACK 12-1(1)             ? 935. LAB PACK 12-1(1)
    ? 936. SEMINAR 12-1(1)              ? 951. SEMINAR 12-1(3)
    ? 937. COMMON FACTORS/GOF           ? 952. COMMON MULTIPLES/LCM
    ? 938. MSM(4) P.200                 ? 953. MSM(4) P.196
    ? 939. MSMWB(5) P.52                ? 954. MSM(3) P.228
    ? 940. MSMD(5) P.42                 ? 955. MSMWB(5) P.54
    ? 941. ESM(5) P.168                 ? 956. MSMPP(4) P.74
    ? 942. ESM(5) P.169 PROB(1-2)       ? 957. MSMD(5) P.43
    ? 943. LAB PACK 12-1(2)             ? 943. LAB PACK 12-1(2)
    ? 944. SEMINAR 12-1(2)              ? 958. SEMINAR 12-1(4)

 ?ACTIVITY
929,931,937,938,945,947,952,953.®
 ?AVAILABLE POST-TESTS:
 ?  1. TA12-1
 ?  2. TB12-1
 ?  3. TC12-1

 ?TEST
1®

 NAME                DATE          UNIT        METHOD          TEST

 BURSE DEBBIE     01/31/75      . UNIT 12-1   STG. R 12-1     TA12-1

 STUDY LIST
     FACTORS                     MSMR(4) P.25
     COMMON FACTORS/GOF          MSM(4) P.200
     MULTIPLES                   MSM(3) P.224(1-6,13-23)
     COMMON MULTIPLES/LCM        MSM(4) P.196
    5
```

The terminal operator types:

1. /P, student identification number and carriage return
2. Numbers of the objectives missed separated by commas and followed by a period and carriage return
3. For each objective missed the title number followed by the individual assignment number separated by commas and followed by a period at the end and a carriage return
4. 1,2 or 3 for the appropriate test followed by a carriage return

Example 5 - Misses one or more objectives on the TC post-test - fast or slow mode.

The student misses one or more objectives on the TC post-test. The computer reassigns the unit.

```
UNIT SELECTION COMPLETE
MICA READY
/P,9®
 ?ENTER TC 7  RESULTS FOR GAMER KRIS          HR 24 MS PIERCE
7.®
 ?REMEDIAL PRESCRIPTIONS:
    ? 787. ADD-SUB:STORY PROBLEMS      ? 791. MSM(4) P.42
    ? 814. EEM(5) P.54-55              ? 335. MSM(5) P.45
    ? 789. STA(4) P.86-89              ? 792. LAB PACK 7(7)
    ? 790. EMWB(5) P.25                ? 793. SEMINAR 7(7)

 ?ACTIVITY
®
ALL TESTS HAVE BEEN PRESCRIBED, A NEW UNIT MUST BE
ASSIGNED OR THE CURRENT ONE REASSIGNED

 GAMER KRIS        01/27/75

 STUDY LIST
     ADD-SUB:STORY PROBLEMS       EEM(5) P.54-55


 PRESCRIPTION SELECTION COMPLETED.

 ?AVAILABLE METHODS:
 ? 1. ST. GUIDE 7
 ? 2. STUDY TAPE

 ?METHOD
1®
ONLY ONE PRETEST IS AVAILABLE: PR 7

 UNIT          METHOD         TEST

  UNIT 7         ST.GUIDE 7    PR 7
   9
```

The terminal operator types:

a. /P, student identification number followed by a carriage return (an F follows the identification number if the fast mode is used)

b. The number(s) of the objective missed followed by a carriage return

c. A carriage return for the best assignment or pairs of assignment numbers for another type of assignment followed by a period and a carriage return

d. 1 or 2 for the method followed by a carriage return

ADDITIONAL ASSIGNMENTS

/A, id mode

Use the /A command to give a student assignments in addition to those he received during his last prescription transaction. This transaction is is quite similar to the prescription transaction. The differences lie in the fact that results are not requested (MICA has the results of the last test in its data base), and a menu of post-tests is not presented)the student will take the post-test assigned him during the last prescription transaction).

The quiz teacher circles those remedial prescriptions on the /P or /A tear-off sheet, which the student is to study. The terminal operator is given the tear-off sheet by the student. The /A command is typed, and MICA prints those prescriptions which were printed when the last test results were entered. Those prescriptions which the student has already been assigned are marked with as asterisk by MICA. The quiz teacher can give additional assignments as many times as he deems necessary. The additional assignments transaction is handled by the Prescription Module and, like the prescription transaction, there is a fast mode of operation. The "mode" is omitted for the normal mode of operation. An F must follow the student ID number to operate in the fast mode. In the fast mode the menu of prescriptions is not printed and the selection of prescriptions is by type (ie., a single number specifying the relative position within the set of eight prescriptions for each item wrong on the previous test).

Example 1 - Slow mode - some objectives missed - objective title paired with assignment. The teacher requests one of the additional types of assignments for some of the objectives missed on the last test. The terminal operator uses the slow mode and pairs the number of the objective title with the number of the selected type of assignment. Note that the asterisks mark those prescriptions which the student has studied.

```
MICA READY
/A,136 ®
 ?REMEDIAL PRESCRIPTIONS:
   *?1253. MULT: 1 PL x 5
   *?1254. MSM4 P.226 PROB.(11-3Ø)
    ?1255. M(4) P116-117(WRITTEN1-7
    ?1256. CSDK CARDS MULT 7,13
    ?1257. EMMD P.2ØØ,2Ø1BOTTOM A-D
    ?1258. MS OF A P.5Ø (SET 111)
    ?1259. MS OF A P.5Ø (SET 111)
    ?126Ø. SEMINAR 13(1)
   *?1269. MULT: 2 PL x 3 PL WITH Ø
   *?127Ø. MSOFA P.92
    ?1271. EA(5) P.69(1-3),186(2-3)
    ?1272. CSDK CARDS MULT 22,23
    ?1273. EA(4) P.247 PROB(6)
    ?1274. EM(6) P.41 PROB(14-15)
    ?1275. EM(5) P.333(SET28,POW2-3
    ?1276. SEMINAR 13(3)
   *?1277. DIV OF HUN: 1ØS-1ØØS Q/R
   *?1278. ESMS P123
    ?1279. EA(5) P.1Ø9 PROB(4-9)
    ?128Ø. NDM(4) P.333(SET 54,3-6)
    ?1281. MSM WB(3) P.112(1-8)
    ?1282. EA(4) P.244 PROB(1-7)
    ?1283. MSMP(6) P.11 PROB(17-28)
    ?1284. SEMINAR 13(4)
 ?ENTER PR13-1 ID PAIRS FOR CHAPIN JOHN
1269,1276. ®
                                        HR 26 MS GRASS

 NAME                DATE       UNIT          METHOD          TEST

 CHAPIN JOHN         11/13/74   UNIT 13-1     STG. 13         PP13-1

 STUDY LIST
     MULT: 2 PL x 3 PL WITH Ø   SEMINAR 13(3)
  136
 ADDITION OF ASSIGNMENTS COMPLETE

 MICA READY
```

The terminal operator types:

a. /A, student identification number followed by a carriage return

b. The number to the left of the objective title followed by the number to the left of the assignment type for each additional assignment separated by commas. The last assignment number is followed by a period and carriage return

The operator then:

c. files the original printout with the other transactions of the day

Example 2 - Fast mode - all of the objectives missed - select by type. The teacher requests one of the additional types of assignments for all of the objectives missed on the last test. The terminal operator uses the fast mode (display of all possible assignments for the objectives missed on the last test is bypassed.

```
MICA READY
/A,136F®
 ?REMEDIAL PRESCRIPTIONS:
 ?ENTER TA13-1 ASSIGNMENT TYPE FOR CHAPIN JOHN
4.®

 NAME                DATE        UNIT          METHOD          TEST

CHAPIN JOHN        11/13/74     UNIT 13-1     STG. 13         TA13-1

STUDY LIST
    MULT: 2 PL x 3 PL WITH Ø     EA(4) P.247 PROB(6)
 136
ADDITION OF ASSIGNMENTS COMPLETE

MICA READY
```

The terminal operator types:

a. /A, student identification number followed by an F and carriage return

b. 3, 4, 5, 6, 7 or 8 for the type of assignment followed by a carriage return

The operator then:

c. Files the original printout with the other transactions for the day

In Example 2 the quiz teacher has noted the fourth prescription is to be assigned to the student. In this example the student has missed only one objective (only one assignment occurs in the study list). If he had missed two, the fourth prescription for both objectives would have been automatically assigned to him and printed in the study list.

SERVICE

/S

The service module performs various housekeeping duties. When /S(R) is typed a menu of the valid commands it recognizes is printed, and the terminal operator is allowed to choose from them. The menu is only printed the first two times /S is typed each day.

The commands and their functions are:

REST - REST allows the operator to leave the room for 5 minutes or more without losing the telephone line because of the TIMEOUT WARNING

TALLY - TALLY is typed if a report of the day's transactions is desired during the run.

Example 1 - REST

```
/S(R)

 ?SERVICE MODULE AT YOUR SERVICE


 VALID COMMANDS ARE:
  REST
  TTY
  HAZEL
  TALLY
REST(R)
 WHEN YOU GET BACK JUST ENTER A /P OR /A TO WAKE ME UP
/P(R)
 THOSE SHORT NAPS ARE GREAT.
 NO STUDENT HAS THAT ID.  ?STUDENT
```

The terminal operator types:
1. /S carriage return
2. REST carriage return
3. /P or /A carriage return
4. The next entry

Example 2 - TALLY

```
/S®

 ?SERVICE MODULE AT YOUR SERVICE

 VALID COMMANDS ARE:
  REST
  TTY
  HAZEL
  TALLY
TALLY®
    /A  /AI  /O   /OI   /OA   /P   /PI   /R   /C   SHR   SHW   SDR   SDW
     Ø    Ø   Ø     Ø     3    7     1    1    2    26     9    26     3
   RS   RC   RU   RG
    Ø    Ø   Ø     Ø
```

The terminal operator types:

1. /S carriage return
2. TALLY carriage return
3. The next entry

TERMINATION

/@

The /@ command is typed to tell MICA that we are done with the program for the day. After this command is entered, the program performs some housekeeping functions and prints some summary statistics about the use of the program. These statistics should be saved for the data base manager. The following example shows the termination of a MICA run as well as termination of communication with the EXEC.

```
/@®
 SHFR UTILIZATION: 29% OF 672

    /A  /AI   /O  /OI  /OA  /P   /PI    /R    /C   SHR    SHW    SDR    SDW
     2    Ø    Ø    Ø    Ø   2     Ø     Ø     4     4      4      4      Ø
   RS   RC    RU  RG
    Ø    Ø     Ø   Ø
 ?ENTER @FIN,E

HAVE A NICE DAY

@FIN,E®

   RUNID: Y27959     PROJECT: 10091              USER: 3914230663

 ITEM                    AMOUNT       COST(DOLLARS)

CPU TIME          Ø:ØØ:Ø2.147           $Ø.19
FILE I/O REQUEST          1ØØ           $Ø.14
FILE I/O WORDS           826ØØ          $Ø.11
INTERACTIONS              25            $Ø.Ø6
MEMORY USAGE            Ø.119           $Ø.21
CARDS IN                  26            $Ø.Ø1
PAGES PRINTED              3            $Ø.Ø5
JOB CHARGE                 1            $Ø.1Ø

TOTAL COST                              $Ø.87

     BASED ON RATES FOR DAYTIME RUNS
PROJ BALANCE                          $1467.81

    INITIATION  TIME:   14:18:1Ø-NOV 13,1974

    TERMINATION TIME:   14:34:5Ø- NOV 13,1974

    PREVIOUS RUN TIME:  14:16:53-NOV 13,1974
 *TERMINAL INACTIVE*
 >Q
```

/R

The reports allow the teacher to request information summarizing student progress on either an individual or group basis. Four basic reports are presently implemented: The study history report gives a complete summary of the activity of a student or group of students after a certain date or for the unit currently assigned. The group summary report gives a summary of the current status of a group of students. The unit report summarizes the students working on given units, ordered with the most widely used units first. /R is typed to put MICA into the report mode.

Report Control Statements

Included in the following discussion are format descriptions and field specifications for report control statements. For each control statement the general form is given first, followed by a description of its use. Next the parameters for the various fields in the statement are presented in chart form together with field descriptions. Comments following the charts refer either to the statement in general or to multiple fields within the statement. Finally, examples and explanations are provided.

CONTACT

C,name,date

When a contact report is requested, the students are listed by group who have not participated in the program since the date specified by the request.

Field	Parameter	Description
name	requester's name	A maximum of 24 characters.
	field not used	The second comma must immediately follow the first comma.
date	mm/dd/yy	Where the mm,dd,and yy are the month, day and year respectively. The month, day and year must be separated by slashes.

The two commas are required, and no spaces are allowed except within the requester's name.

The contact report is requested as follows:

1. With the name shown: /R(R)

   REPORT MODULE READY

   C,MS WALLEN,12/9/74(R)

   The terminal operator types:
   a. /R carriage return
   b. C, requester's name, date specified carriage return

2. Without the name shown: /R(R)

   REPORT MODULE READY

   C,,12/9/74(R)

   The terminal operator types:
   a. /R carriage return
   b. C,, date specified carriage return

Example - requester's name shown

```
/R®
 REPORT MODULE READY
C,MS GRASS,11/1/74®

*****************************
*                           *
* REPORT OF NONPARTICIPANTS *
*      SINCE 11/ 1/74       *
*       REQUESTED BY:       *
* MS GRASS                  *
*                           *
*****************************

GROUP 1

 NAME              ID# UNIT         METHOD       TEST   DATE ASSIGNED

ANTHONY FARINA     137 NOTHING HAS BEEN ASSIGNED TO THIS STUDENT.
DON HAFEMAN        138 NOTHING HAS BEEN ASSIGNED TO THIS STUDENT.


GROUP 2

 NAME              ID# UNIT         METHOD       TEST    DATE ASSIGNED

BARLOW STEVE       139 NOTHING HAS BEEN ASSIGNED TO THIS STUDENT.


GROUP 3

 NAME              ID# UNIT         METHOD       TEST    DATE ASSIGNED


GROUP 4

 NAME              ID# UNIT         METHOD       TEST    DATE ASSIGNED

RIDDLE CLIFF        8Ø UNIT 3       ST. GUIDE 3  TA 3      1Ø/28/74


GROUP 5

 NAME              ID# UNIT         METHOD       TEST    DATE ASSIGNED


GROUP 6

 NAME              ID# UNIT         METHOD       TEST    DATE ASSIGNED
```

GROUP

G,name,group#

When a group summary report is selected, the desired group ID is read from the request. For each student in the group, the name of the current unit, method, and test assigned are reported.

Field	Parameter	Description
name	requester's name	A maximum of 24 characters may be used.
	field not used	The name may be omitted by having the second comma immediately follow the first.
group #	1-2 digit number	The number of the group to be reported.

The two commas are required, and no spaces are allowed except within the name.

The group report is requested as follows:

1. With the name shown:

```
/R (R)
 REPORT MODULE READY
G,WALLEN,3(R)
```

The terminal operator types:
a. /R carriage return
b. G, requester's name, the group number and carriage return

2. Without the name shown:

```
/R (R)
 REPORT MODULE READY
G,,3(R)
```

The terminal operator types:
a. /R carriage return
b. G,, group number and carriage return

Example 1 A Group Report

```
/R®
 REPORT MODULE READY
G,SUE HAFEMAN,4®
```

GROUP REPORT
****

TEACHER: SUE HAFEMAN 11/18/74 GROUP 4

STUDENT	ID#	UNIT	DATE	METHOD	TEST	DATE
ESCH BRUCE	63	UNIT 3	10/28	ST.GUIDE 3	TB 3	11/13
ESRCH DUKE	64	UNIT 3	11/13	ST.GUIDE 3	PR 3	11/13
FLAM FLIM	65	UNIT 9	11/ 4	ST.GUIDE 9	TB 9	11/13
GOSH DARM	66	UNIT 2-2	11/14	ST.GUIDE R2	PR 2-2	11/14
JORDON SCOTT	67	REVIEW 1	11/14	TEST	R1-PTA	11/15
MANN WOOLEY	68	UNIT 9	10/31	ST.GUIDE 9	TB 9	11/12

UNIT

U,name,unit

When a unit summary report is specified, the student data records are searched in turn for all students working on each unit, and the units are sorted in decreasing order by number of students working on the unit. The information output consists of the unit names, the total number of students currently working on each unit, and their names and ID numbers.

Field	Parameter	Description
name	requester's name	A maximum of 24 characters may be used.
	field not used	The second comma must immediately follow the first.
unit	unit name	Name of a unit in the curriculum. Only the one unit is reported.
	field not used	All units are reported on.

The two commas are required, and no spaces are allowed except within the requester's name.

The unit report for students working on a single unit is requested as follows:

1. With the name shown:

```
/R®
 REPORT MODULE READY
U,MS ELMER,UNIT 3-1®
```

   The terminal operator types:
   a. /R carriage return
   b. U, requester's name, unit requested,carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
U,,UNIT 3-1®
```

The unit report for students working on each unit in decreasing order by number of students is requested as follows:

1. With the name shown:

```
/R®
 REPORT MODULE READY
U,BERNEICE SCHNEIDER,®
```

   The terminal operator types:
   a. /R carriage return
   b. U, requester's name, carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
U,,®
```

   The terminal operator types:
   a. /R carriage return
   b. U,, carriage return

Example - Unit Report - Single Unit - Requester's name shown.

```
/R®
 REPORT MODULE READY
U,MS PIERCE,UNIT 9®


*****************************
*       UNIT REPORT         *
*                           *
* MS PIERCE                 *
*       11/18/74            *
*                           *
*****************************


  UNIT NAME          NUMBER ACTIVE
  UNIT 9                    14
   4 FALCH BRUCE
   6 KAMP KIM
  46 KENDALL BRAD
  55 LAABS KAREN
  65 LAING LINDA
  68 LUBINSKY RICKY
  74 MIDSTOKKE KEN
  77 MINOR LYNN
 1Ø5 NIFMAN LIZ
 1Ø8 RICHARDS KRIS
 12Ø RICHTER DOUG
 122 RIDDLE CLIFF
 129 RIGGINS SHEILLA
 136 THOMAS DEBBIE
```

STUDENT HISTORY

S,name,date,id#speci

When a student history report is requested, either an individual student number or a group ID is entered. A date may optionally be typed, indicating that only those units started after that date are to be printed. If no date is entered, only the current unit will be printed for the specified student(s). The information printed consists of all the data collected on the student(s) from the units assigned.

Field	Parameter	Description
name	requester's name	A maximum of 24 characters may be used.
	field not used	The second comma must immediately follow the first.
date	mm/dd/yy	Where mm, dd, and yy are month, day and year separated by slashes. The report includes all activities on the student(s) since the date specified. If the parameter is not used (third comma immediately follows second comma), only the current unit is reported.
id#specl	nnnl	Where nnn is a student or group identification number and l is an S or G, signifying the number is a student or group number respectively.

The three commas are required, and no spaces are allowed except within the requester's name.

The individual current unit student history report is requested as follows:

1. With name shown:

```
/R®
 REPORT MODULE READY
 S,SUE WALLEN,,88S®
```

The terminal operator types:
a. /R carriage return
b. S, requester's name,, student math identification number S carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
S,,,88S®
```

The terminal operator types:
a. /R carriage return
b. S,,,student math identification number S carriage return

The individual dated student history report is requested as follows:

1. With the name shown:

```
/R®
 REPORT MODULE READY
S,PIERCE,9/2/74,75S®
```

The terminal operator types:
a. /R carriage return
b. S, requester's name, date specified, student math identification number S carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
S,,9/2/74,75S®
```

The terminal operator types:
a. /R carriage return
b. S,, date specified, student math identification number S carriage return

The group current unit student history report is requested as follows:

1. With the name shown:

```
/R®
 REPORT MODULE READY
S,PEARSON,,6G®
```

The terminal operator types:
a. /R carriage return
b. S, requester's name,, group number G carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
S,,,6G®
```

The terminal operator types:
a. /R carriage return
b. S,,, group number G carriage return

The group dated student history report is requested as follows:

1. With the name shown:

```
/R®
 REPORT MODULE READY
S,MS GRASS,9/2/74,G®
```

The operator types:
a. /R carriage return
b. S, requester's name, date specified, G carriage return

2. Without the name shown:

```
/R®
 REPORT MODULE READY
S,,9/2/74,G®
```

The terminal operator types:
a. /R carriage return
b. S,, date specified, G carriage return

On the following page are two examples of student history reports. The first is a request for all the information in the data base on a particular student since a specific date. The second request is for information on a particular student pertaining to his current assignment only.

Example 1 - Individual dated student history report - requester's name shown.

```
/R®
 REPORT MODULE READY
S,MR. CHAPIN,11/17/74,85S®


          S T U D E N T   H I S T O R Y   R E P O R T
          ******************************************


    TEACHER: MR. CHAPIN                          DATE: 11/18/74
    ALL UNITS STARTED SINCE; 11/17/74

 ESCH BRIAN          ID NO.  85
      UNIT; UNIT 6-1       DATE  11/14/74  METHOD; ST.GUIDER6-1
       TEST: PR 6-1     DATE: 11/14/74
        RESULTS:  1, 2, 4,
        PRESCRIPTIONS:
         SET LISTING/DESCRIBING
         MSM(4) P.1,2
         EQUAL/EQUIV/CARD NO/EMPT
         MSM(4) P.3,4
         FINITE/INFINITE
         MSM(4) P.5
       TEST: TA 6-1      DATE: 11/18/74
```

Example 2 - Individual current unit student history report - requester's name shown.

```
/R®
 REPORT MODULE READY
S,MR. LORENZ,,84S®


          S T U D E N T   H I S T O R Y   R E P O R T
          ******************************************


      TEACHER: MR. LORENZ                        DATE: 11/18/74
      CURRENT UNIT REQUESTED

 BUTLER TERRIANNE      ID NO. 84
       UNIT; UNIT 3          DATE; 11/15/74  METHOD; ST.GUIDE 3
        TEST: PR 3        DATE: 11/15/74
```

UNIT ACHIEVEMENT LIST

L,name,date,ID#spec$_1$

When a unit achievement list is requested, either an individual student number or group ID is entered. Date is optionally entered. The date, if entered, specifies that the unit achievement list includes only those units started since that date. If date is omitted, listing will start on the day the student began participation in the program. The output consists of the student name, ID number, names of all units started since the specified date, the date each unit was started and completed, the total number of days spent on each unit, and the number of tests the student took within each unit. Each student's list ends with a comparison of the students performance with his peer group.

This report requires that summary statistics be compiled for each peer group prior to the printing of the Unit Achievement List. One day advance notice is sufficient for the data base coordinator to update the summary statistics. If the report is requested and the summary statistics are more than 2 weeks old, the terminal operator receives a diagnostic in place of the report.

Field	Parameter	Description
name	requester's name	A maximum of 24 characters may be used
	field not used	The second comma must immediately follow the first.
date	mm/dd/yy	mm=month, dd=day, yy=year must be separated by slashes. The listing includes all activities since date specified. If parameter not used (third comma immediately follows the second comma), all activities since student's participation are reported.
id#spec$_1$	nnn1	nnn=student or group ID 1 = S (for student number) or = G (for group number)

Example 1

```
/R

REPORT MODULE READY

L,MS GRASS,,362S

*****************************
*                           *
*     SHERMAN SCHOOL        *
*   MATHEMATICS PROGRAM     *
*                           *
*  UNIT ACHIEVEMENT LIST    *
*   FOR THE PARENTS OF      *
*     JIM BROWN             *
*                           *
*   DATE:  6/ 8/ 74         *
*                           *
*****************************

UNIT          DATE STARTED   DATE FINISHED   NUMBER OF DAYS   NUMBER OF TESTS

UNIT 1-1      9/9/74         9/11/74         3                 2
UNIT 1-1      9/11/74        9/12/74         2                 2
.
.
.
UNIT 4-2      11/12/74       11/13/74        2                 1

YOUR CHILD COMPLETED 21 UNITS.
THE AVERAGE 4TH GRADE STUDENT COMPLETED 19 UNITS.
```

SHERMAN INSTRUCTIONAL SEQUENCE

After the first series of survey tests are administered in the homerooms, the following sequence of steps is typical in the instructional process.

A student enters the test room where he takes the appropriate test from the folio cabinet. The student also picks up the unit objective missed list (UOML) (half sheet). The student will also be carrying with him his print out from the terminal (the bottom half of which contains the assigned prescription and his student number). Before handling his test to the aide to be corrected, the student fills in the information at the top of the unit objective missed list: The student's first and last name, the unit, the test, and the student's math number. The aide, while correcting the test, will also indicate on the UOML the objectives that the student missed. More than one mistake out of five is considered a miss. At the bottom of the UOML the aide will stamp the date the test was taken. Previously the student has stapled the UOML to the students portion of the print out.

If the student failed the test, the UOML and the print out are taken to the terminal room where they are dropped in a basket for the terminal aide. After the student has dropped off the UOML, he or she takes the corrected test to a review teacher. There the student and the teacher discuss the exam in a one-to-one situation. The student leaves the review room and goes to the study room. There, waiting for him will be an assignment and the appropriate text. While he was reviewing, the terminal operator had entered his test results and generated an assignment for the student. This assignment and appropriate text were then sent to the study room.

Normally the aide will select the best prescription for the student unless the books are not present, at which time alternatives can be chosen on the basis of what is available. In the terminal room will be a student helper who takes the new printout from the terminal and finds the book corresponding to the FIRST objective missed by the student. The student helper will then place the book with the print out in the first or appropriate page on the table near the door. Another helper will take the assignment and the book to the student's study room. If the student passed the test, the review teacher will assign to the student an appropriate next unit which will be recorded on the UOML. This and the test results will be taken to the terminal room where students going on to a new unit will receive the study guide along with the new print out.

After the student has been given either an assignment for missed objectives or a study guide for a new unit, the student works on the assignment in the study room. If it is a missed objective (students work on missed objectives one at a time) the student will have one text book that will be used to do a problem set. The study teacher will help the student with the assignment, and when finished the student can use the teacher's edition to check the work with the help of eitherstudent checkers or teachers. If the student is working on a study guide, the student does the sink or swim at the back as a self check.

Once the assignment or the sink or swim is completed, the student goes to the next station in the program. If the student is working on a study guide and sink or swim, the next station is the testing room where the pre-test is taken and the instructional sequence begins again (1). If the student has been working on an assignment dealing with a missed objective, the next station is the quiz/ room. There the quiz teacher determines whether the student has learned the objective missed on the previous test. If the teacher,

through the use of the quiz cards or any other approach, determines that the student does understand the objective, the student goes back to the test room and picks up the next post-test in the current unit. This test is listed on the student's print out and should be circled by the quiz teacher.

If the quiz teacher thinks the student does not understand the objective, the teacher can select from the lsited prescriptions on the print out alternative experiences for that objective. This is indicated by simply circling the number of the optional prescription on the print out. One also writes update on the hard copy so the aide will notice it when entering the information. The student will then leave the quiz/ review room and go either to the terminal/ book room for a textbook and then to the study room or to the seminar or lab room if that prescription had been assigned as an optional experience

After completion of an optional assignment, the student always returns to the quiz/ review teacher for either reassignment or permission to go to testing.

When returning to the test room the student must take his old hard copy print out so it can be stapled to the COML. This allows the aide to update the prescription record of the student. On the new print out those assignments already given will be preceded by a * o the quiz/ review teacher will know what has already been assigned.

After completing an assignment or study guide the student should return it to the book cart in front of the terminal room so it can be recycled back into the instructional process.

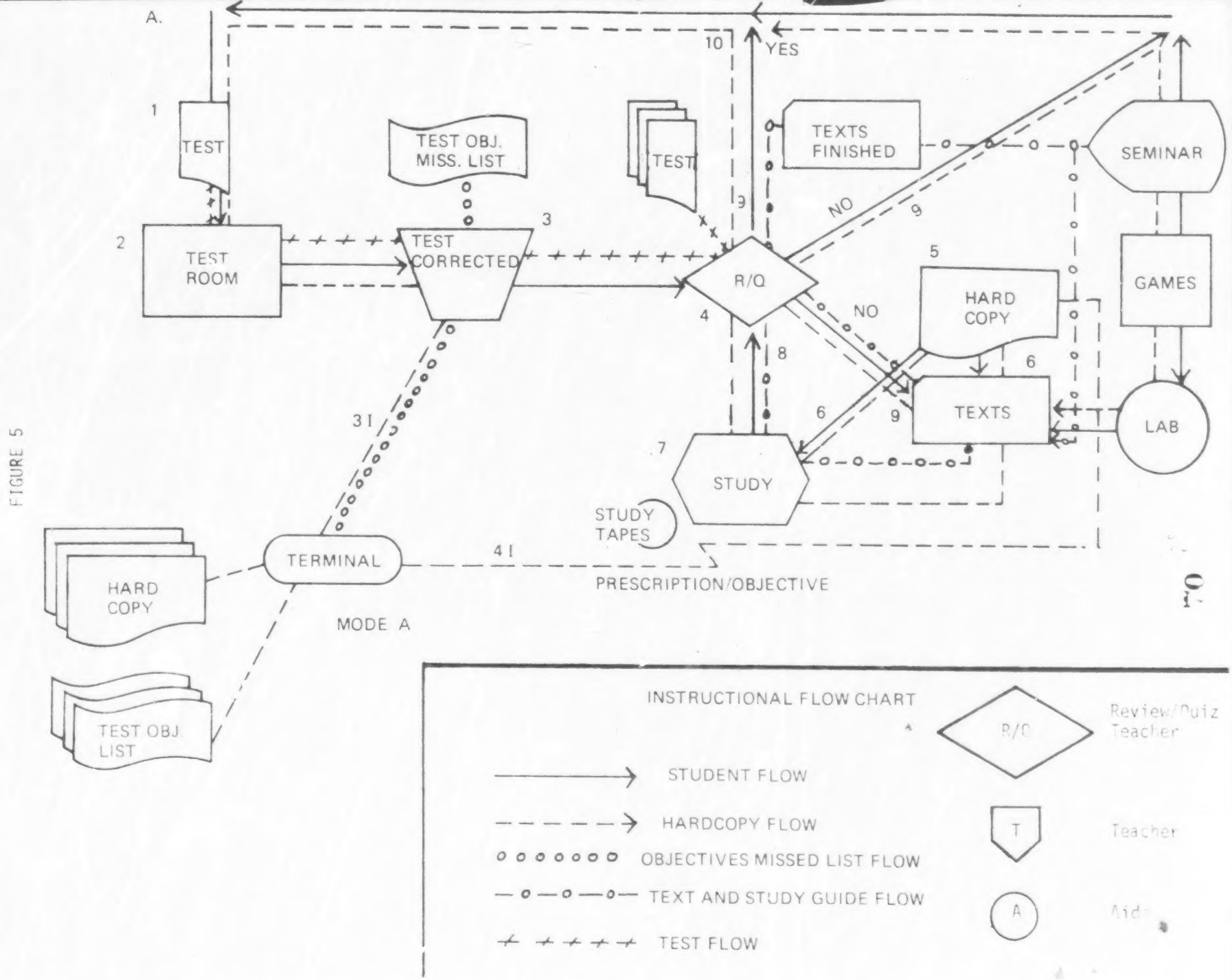

A.
1
TEST
2
TEST ROOM
TEST OBJ. MISS. LIST
3
TEST CORRECTED
TEST
10
YES
TEXTS FINISHED
SEMINAR
NO
9
5
R/Q
4
HARD COPY
GAMES
NO
8
6
TEXTS
LAB
6
9
7
STUDY
STUDY TAPES
3 I
TERMINAL
4 I
PRESCRIPTION/OBJECTIVE
HARD COPY
TEST OBJ. LIST
MODE A
INSTRUCTIONAL FLOW CHART
R/Q
Review/Quiz Teacher
STUDENT FLOW
HARDCOPY FLOW
T
Teacher
OBJECTIVES MISSED LIST FLOW
TEXT AND STUDY GUIDE FLOW
A
Aide
TEST FLOW

FIGURE 5